CAREERS IN SCIENCE

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ERINARYPATHOLOGYPHYSIOLOGY

CHOOSE YOUR OWN ADVENTURE

We need scientists like we need air and water. That's how important they are.

Science is the best way of understanding and changing the world in which we live. Finding out about things, what they are and how they work, coming up with new ideas as to why this might be or how to change them, then testing those ideas using logical, systematic, unbiased experiments that are able to be repeated by others in exactly the same way, makes science a unique, invaluable discipline.

This booklet includes information on careers in science. It also explains how subjects such as physics, chemistry, biology, earth science and mathematics help broaden the choices you can make for university subjects and careers.

Scientists (including those who have been recognised internationally for their work), science recruiters and those who have put their scientific skills to work in fields outside science all tell their stories in the booklet.

More information can be found at www.careersinscience.gov.au

Australia's four leading, and largest, science agencies are the Australian Institute of Marine Science (AIMS), the Australian Nuclear Science and Technology Organisation (ANSTO), the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and the Defence Science and Technology Organisation (DSTO). Together, they employ over 7 000 scientists. Universities, Cooperative Research Centres and mining, pharmaceutical and technology companies are other large employers of scientists and science technicians.

Scientists help save lives, preserve the environment and improve the way in which we live. No other field has the same potential to leave such a deep, lasting legacy for the benefit of people, societies and cultures.

We need scientists like we need air and water. That's how important they are.

There are lots careers in science. Long term careers. Careers fir scientists, as well as for the technicians, managers and administrators that support them.

Jobs in the field are increasing. But to have better access to these opportunities you need to enrol in science subjects in upper high school. Taking science subjects like physics, chemistry and biology actually means you will have more career options to choose from when you get really serious about lifestyle after school.

Studying science doesn't just fill you up with facts and figures about how the world works; it gives you an invaluable range of problem-solving skills that employers want. A small selection of some non-science fields where scientific training is prized includes law, teaching, journalism, business and management, stockbroking, risk analysis and engineering

But the best reason for studying science is because it's exciting. As our Chief Scientist, Robin Batterham, says, "Imagine creating robots that navigate themselves based on the way insects see, searching for Earth-like planets in the far reaches of space, developing a brain-machine interface so a prosthetic limb can be made to move just by thinking about it, or reinventing cars to be environmentally friendly."

Our world would not be the way it is today without science. From the way we communicate to the way we travel, from the clothes we wear to the houses we live in, from the food we eat to the way we are entertained – all have been shaped by science.

Scientists exist at the edge of imagination. Their work takes us into uncharted territory, so being a scientist involves moral responsibility as well as savvy and creativity. They develop sharp analytical skills and can work for long periods in search of a breakthrough.

Perhaps because so many people are interested in science and what it can do, scientists themselves are held in high regard by society.

Scientists often work in teams, but many also blaze their own trails. Often this involves international travel and overseas postings, making cross-cultural and communication skills very important.

Certainly, careers in science can be uncertain at times, and some may rely on funding which can run out, but Australia's leading science agencies, for instance, employ thousands of scientists in work-friendly environments at attractive rates of pay. Employment opportunities will increase as leading-edge research generates high-tech industries that result in a range of new applications in society.

In some areas of science, there are currently not enough science graduates for the work available and this trend is expected to continue. This means that when you become a scientist you will have a wide choice of positions.

Now is a great time to make an investment in your future and to challenge yourself to make a positive difference in the world.

FROM THE HORSES' MOUTHS!

ENGINEER

Renee Lucas is a metallurgical engineer with Rio Tinto Technical Services. She looks for new ways of getting minerals out of ore bodies. She also has a degree in business administration.

"When I was in year ten I enjoyed science and I was chasing a challenging and different job that was well paid," says Renee. "What I've learnt is that job satisfaction is more important than anything else. You have to go into what you love and what you're passionate about.

"Science is challenging and it opens doors up for you at uni and in later life."

CHEMIST

Dr Chris Griffith is a chemist with the Australian Nuclear Science and Technology Organisation.

"I work on decontaminating nuclear waste using specially designed materials," Chris says. "These materials remove the few radioactive atoms of one element out of mixtures which contain several million non-radioactive atoms. However, being a scientist doesn't condemn you to life in a white coat!

"Through science I've seen a reasonable portion of the world, which has certainly helped me explore my water skiing, hiking and canyoning interests! In high school, I was always pretty inquisitive, so studying science was a good way to find out how things work."

ECOLOGIST

Scott Burgess works with the Australian Institute of Marine Science as a benthic ecologist (studying the ocean floor).

"I don't like being stuck in an office," says Scott. "So the best part of my job is going out to sea. I spend 80-100 days per year monitoring the long-term health of the Great Barrier Reef. I identify corals, their abundance and cover, and I collect data on things that kill coral, such as disease, crown of thorns starfish and snails that eat the coral.

"Even if you don't want to be a scientist, having a science background really helps you understand how our world works and teaches you how to think about and solve problems, which are skills you use in everyday life and whatever career you choose.

"When I was at school I hated maths, I thought it was useless. Now that I've worked around a bit, I can see all the applications where I could use maths."

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ROBOTICS

Phil Valencia is part of the robotics group at CSIRO's Information and Communication Technology centre in Queensland. He's involved in a project linking sensors into networks that behave intelligently.

"I had a lifelong dream to work with NASA, and I kinda thought it would never happen, but when I finished my double degree in electronic engineering and IT, I went to work with CSIRO and within six months I was working on a project with NASA."

ENGINEER

Suzana Turk is a materials engineer with the Air Vehicles Division of the Defence Science and Technology Organisation.

"I'd always loved science from when I was a little kid, but I had no idea what I'd do," says Suzana. "When I didn't get a high enough mark to go straight into uni, I did a TAFE materials engineering course, which was very hands-on rather than full of maths. After a year I transferred to uni and did engineering.

"Any science you do can help in some way, no matter what you end up doing.

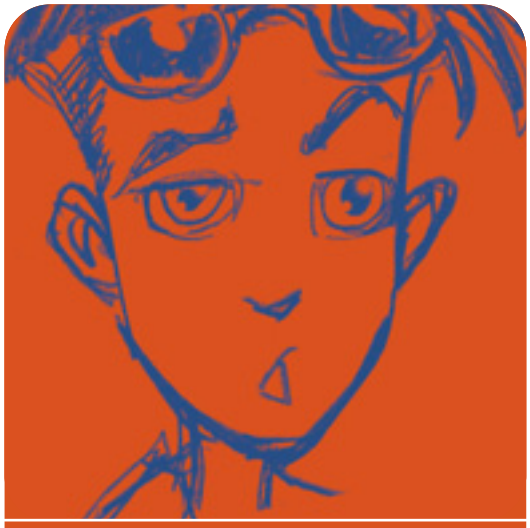
"I wish I'd known about all the different jobs I could do with the subjects I'd studied."

CHEMIST

Jason Farrugia is a polymer chemist who builds binders to go in water-based paint (so the pigments stick to the surface being painted) for Dulux, part of Orica Consumer Products.

"I did chemistry and accounting in high school and enjoyed them both," says Jason. "It made sense to keep going, so I did a double degree in chemistry and commerce. I applied for jobs in both and, when I was being interviewed for the finance ones, they were quite interested in my science skills because of how scientists break down problems.

"Even in the commercial world, analytical thinking is valuable. When it comes to real high-end economics for instance, people employ mathematicians, statisticians and physicists, not people with commerce degrees."



"...AND WITHIN SIX MONTHS I WAS WORKING ON A PROJECT WITH NASA."

"I DON'T LIKE BEING STUCK IN AN OFFICE."

FROM THE HORSES' MOUTHS!

AGRICULTURAL OFFICER

You probably know Suzy Balogh from the Athens Olympics when she became the first Australian woman to win a gold medal in shooting. Her day job is as an Agricultural Protection Officer with the NSW Department of Primary Industries. Suzy is responsible for giving out advice about pest animals – including locusts – and training her colleagues and farmers to control them.

"One of the best bits about my job is that I'm helping the environment, agriculture and people. The bad part is when you're so close to solving a problem that it can frustrate you when other things get in the way.

"There's definitely a career path. There are so many things I could do in the environmental sciences."

"One of the best things about doing science is that when I watch things like CSI, I get it. Even in clay target shooting, I'm using physics all the time."

DERIVATIVES TRADER

Matthew Coleman is a credit rates derivatives trader with the Commonwealth Bank, but he started out by earning a PhD in neurophysiology.

"I knew my specific technical skills would not be transferable," says Matthew, explaining how he switched from science to finance. "So I turned to my generic skills – gathering information from disparate sources, drawing logical conclusions from them, crunching numbers and driving spreadsheets – and searched around for industries that need those skills, and that's how I got into finance.

"Science teaches you independent thinking skill- it is thinking training – and today more than ever you need to be able to cut through marketing hype to find the truth."

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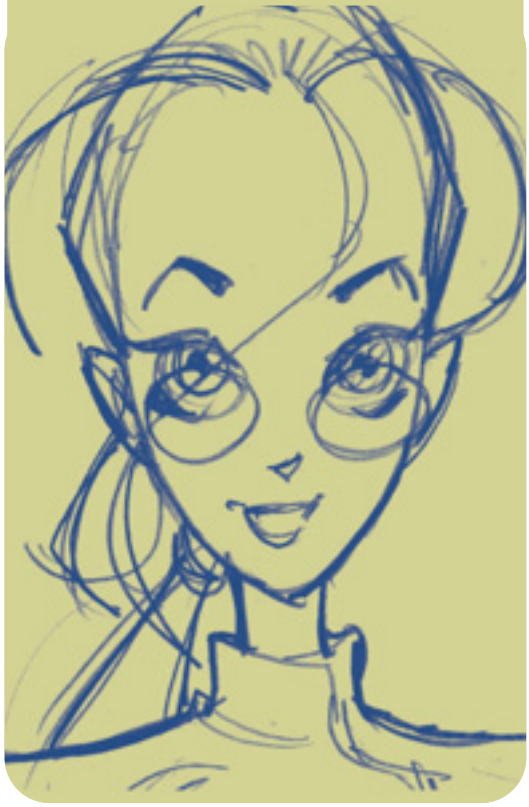
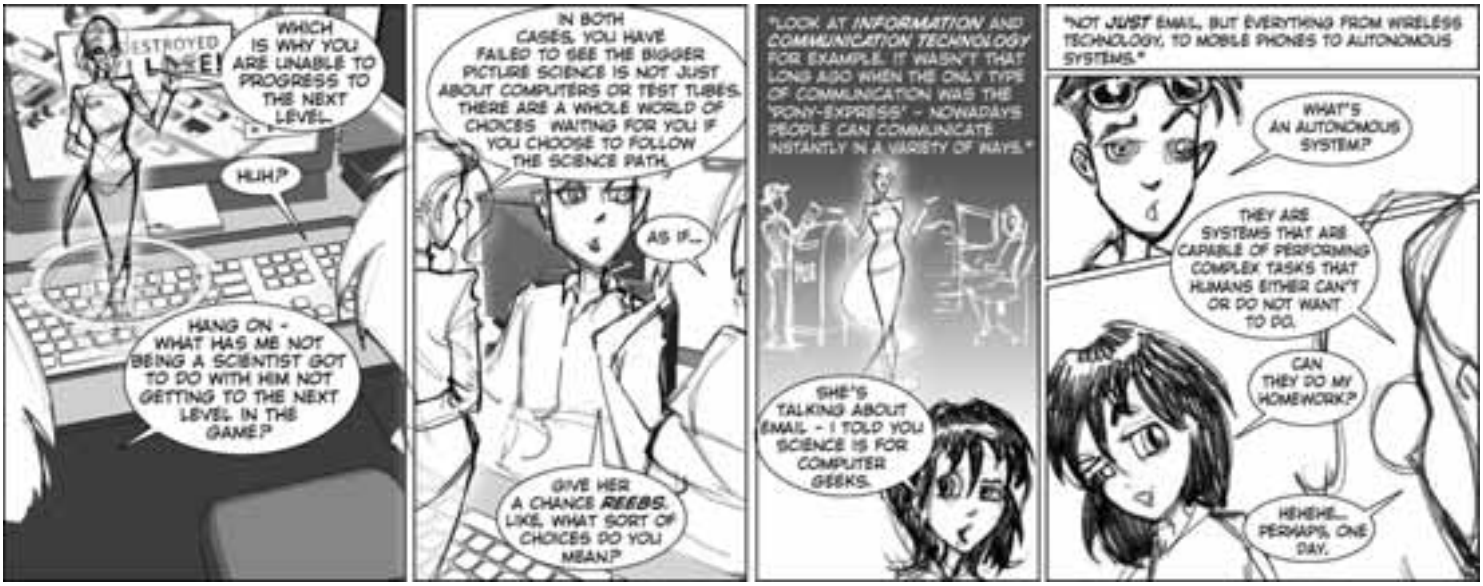




WINEMAKER

Frank van de Loo is a partner in a winery at Mount Majura, near Canberra. He gets to do everything from planting the cuttings, establishing the vines, producing the grapes, bottling the wine and, finally, taking it to market.

An ex-research scientist, Frank he felt that being involved in a narrow scientific area for an entire career didn't suit him. He then discovered the second love of his life, wine-making!

"Having a great science background in plant biology allows me to look at the wine-making process from a different perspective," says Frank. "I am able to think about the effects of different practices, avoiding problems and trying to achieve the best possible outcome"

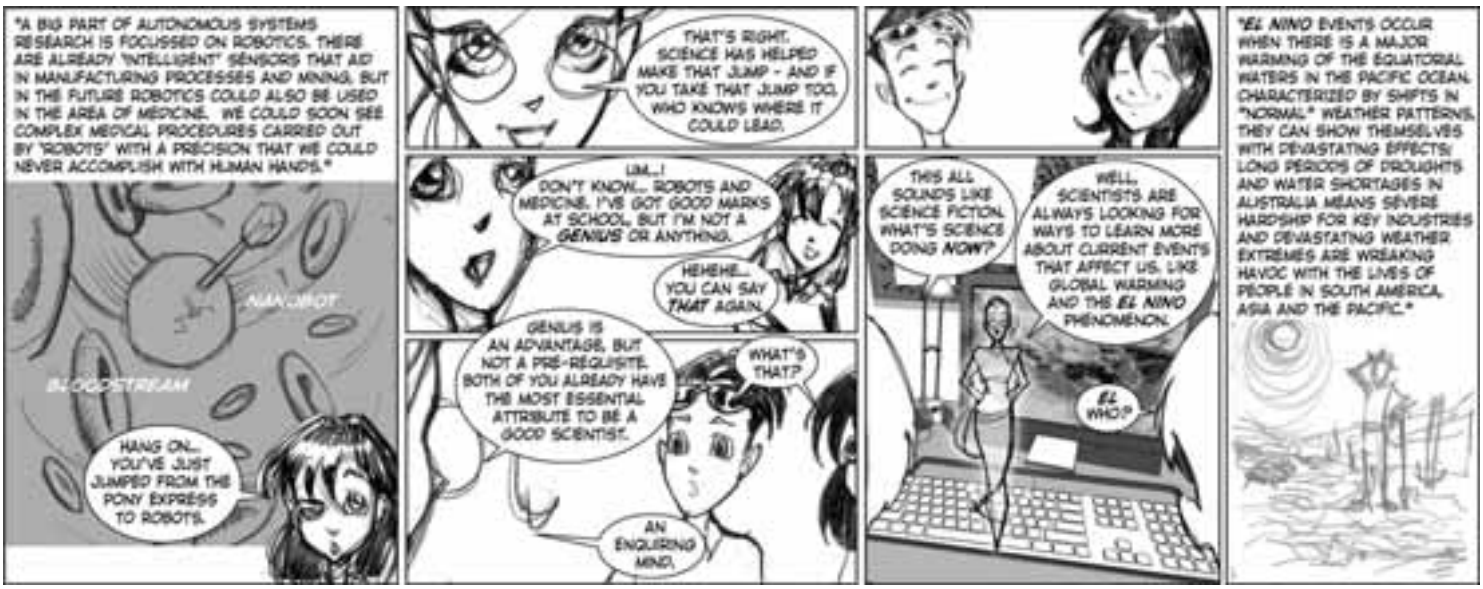
ECOSYSTEM TECHNICIAN

Gus Wanganeen is a technician with CSIRO Sustainable Ecosystems, based in Darwin. He works on a number of projects that look at the important roles that termites and other soil bugs play in keeping tropical savannah landscapes healthy. Bugs can, for example, help to recycle nutrients and water.

Having grown up in South Australia in an Aboriginal community that operated like a small farming community, Gus has always wanted to work outdoors and with nature.

"I worked at Kakadu National Park for 15 years, where I was involved in fauna surveys and research working with small mammals. My training was largely on the job which was challenging and very rewarding, I am now doing other interesting work and projects that are satisfying and involve the outdoors lifestyle that I love."

" I AM NOW DOING OTHER INTERESTING WORK AND PROJECTS THAT ARE SATISFYING AND INVOLVE THE OUTDOORS LIFESTYLE THAT I LOVE."



THESE GUYS HAVE BEEN AROUND

SIR GUSTAV NOSSAL

"I will never regret spending my life in science as I feel I have been an eyewitness to history in the making," says one of Australia's most widely known and respected scientists, Sir Gustav Nossal (or Sir Gus, as he is generally known). "Science and technology will shape the 21st century more than any other force. A life in science, therefore, is a life led for the future of our nation. A career in science is immeasurably fascinating, challenging and rewarding."

Though officially 'retired', Sir Gus runs his own company, striving to improve infant health.

"I'm working with the World Health Organization and the Bill and Melinda Gates Foundation – who've decided that third world health is their top priority. Basically, I'm helping decide how best to spend Mr Gates' money," Sir Gus says.

"The best part of being a scientist is pitting your wits and skills against the unknown to prise out of nature her most jealously guarded secrets; plus you're working on the international stage and that's heady competition. The worst aspect is increasing managerialism and administration.

"To do science you need to have analytical intelligence, be creative and imaginative and, something a lot of people don't realise is that science is incredibly competitive, so you have to have a lot of drive."

"THE BEST PART OF BEING A SCIENTIST IS PITTING YOUR WITS AND SKILLS AGAINST THE UNKNOWN TO PRISE OUT OF NATURE HER MOST JEALOUSLY GUARDED SECRETS..."

DR KARL

"Don't worry about your first degree, do something that's fun and which interests you because your first degree is just what you do on the way to doing your next degree," says Dr Karl Kruszelnicki, who has qualifications in physics, engineering and medicine.

"Physics is a really good thing to do because you won't get fooled again," he says. "You can see the universe with a poetic sense of awe and wonder and be impressed: but with physics you can understand it – and it doesn't take away from the awe and wonder, you just see it on two levels."

Just because you study science, doesn't mean you have to wind up being a scientist. According to Dr Karl: "Half the people in the derivatives markets in London come from science, and they're earning more than a million bucks a year." It's something to do with Stefan-Boltzman equations of heat transfer[1], apparently.

1 Josef Stefan and Ludwig Boltzmann were Austrian physicists. Around 1880, Stefan worked out that energy (such as heat) radiating from an object is proportional to its temperature and Boltzmann described the relationship mathematically.

DR COLIN TAYLOR

Dr Colin Taylor, Executive Director of the Australian Science Innovations (the organisers of the Australian Science Olympiads–an international competition for high school students) has a PhD in physics. "I worked in laser frequency standards, which has applications in telecommunications, cramming stuff into a small bandwidth, and then I spent five years in research. Having a science background adds a dimension that other people in my area simply don't have.

"Most people who went through uni with me aren't working explicitly in science. I have a friend who has a PhD in nuclear physics; he works in the public service in telecommunications influencing policy decisions. When they're doing things like mapping mobile phone black spots, he can really cast a critical eye over it.

"The biggest task you've got in year ten is to figure out what you love doing and do it.

"If you don't stop asking questions when a teacher says, 'I don't know', then you're likely to make a good scientist."

AN AUSTRALIAN NOBEL WINNER

Dr Peter Doherty started his career as a vet in rural Queensland. He did a PhD in the UK, where he and colleague Rolf Zinkernagel made the discovery that ended up winning them the Nobel Prize for Physiology or Medicine in 1996.

"I was interested in learning and creativity because I think I realised even then that education was a way up, and a way out," says Peter. "University was a transformation for me, a real freedom to learn and explore like never before.

"To be a good scientist, you've got to be very persistent and totally absorbed in what you do. You need to have an open mind, and be prepared to drop one line of inquiry and follow another if it looks interesting.

"There are easier ways to make a living. But science has to be one of the most interesting pursuits. It doesn't matter who you are or where you come from, you can excel in science."

To find out more about Nobel Prizes, go to www.careersinscience.gov.au/nobel

"PHYSICS IS A REALLY GOOD THING TO DO BECAUSE YOU WON'T GET FOOLED AGAIN."

WHAT THE RECRUITERS SAY

"We have about 32 scientists, and lots of honorary associates and students, who are largely geared around looking after and adding to our natural science collections and providing info about them," says **Dr John Long, Head of Sciences with Museum Victoria**.

Any scientist who has anything to do with the natural world could get a job in a museum. John mentions marine scientists, entomologists, mineralogists and zoologists. But there are also science communicators, exhibit designers and technical staff.

The average museum curator gets $42-58K, and a senior curator gets $50–78K.

"Science is terribly exciting and rewarding in terms of level of happiness, which is worth a lot more than doing a job you hate for twice the money."

Where will the jobs be in five to ten years? John suggests environmental science because of new regulations compelling mining companies to do more environmental monitoring.

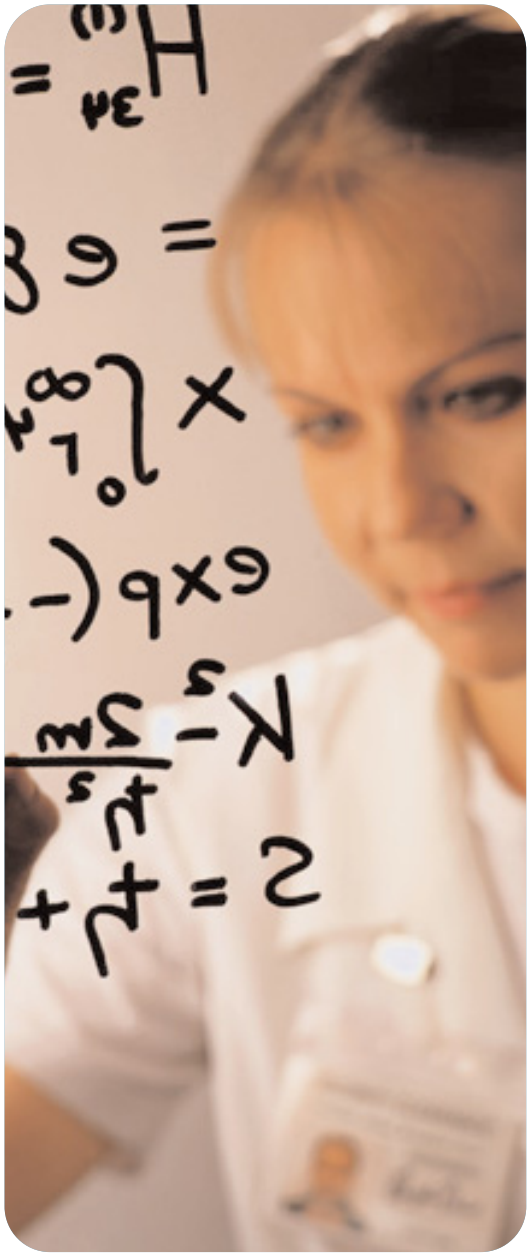
Rachel Schmitt did a BSc and was a human biology teacher before she took up her current position as a **prospective students officer at the University of Western Australia**.

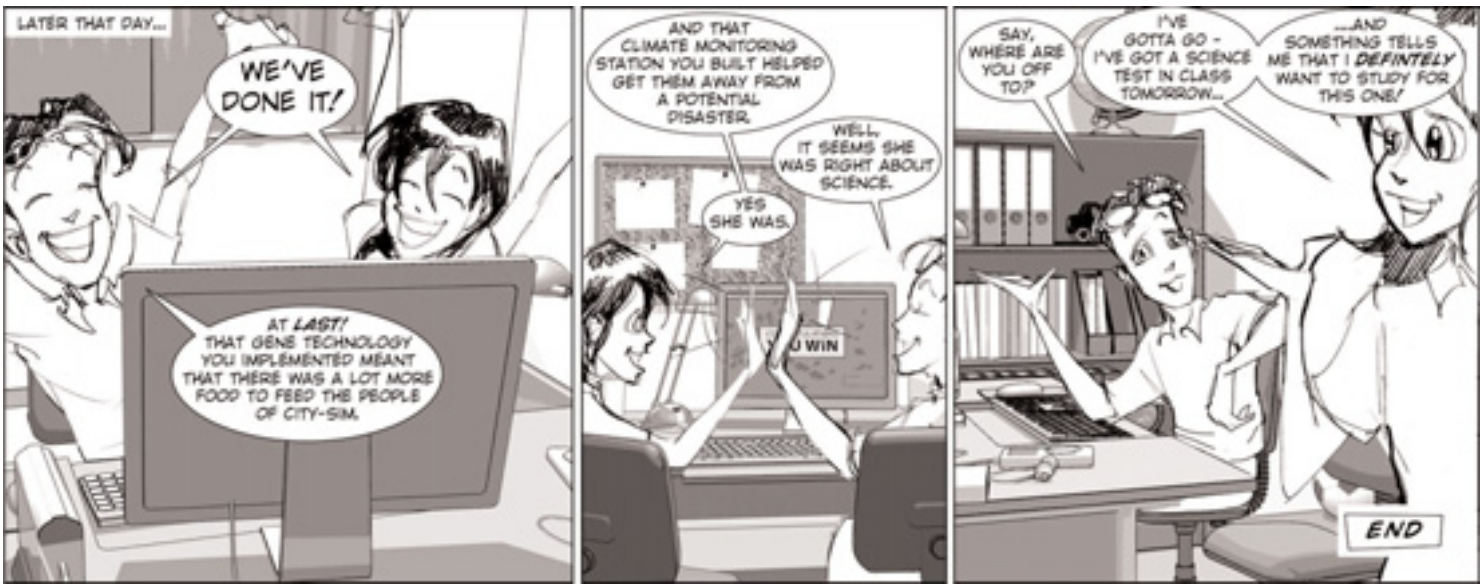
"Doing some science in Years 11 and 12 won't penalise you at all no matter what subjects you want to study at university," says Rachel. "And all those skills you get from doing science subjects, such as problem solving and understanding the scientific method, will help you in other courses.

"At many unis, if you look at the prerequisites across arts, sciences, and even business degrees ,if you haven't got maths, you're cutting off a lot more options."

"CSIRO has about 4 900 scientists, engineers and technicians and we hire about 1 000 a year," says **Anthea Roberts, a People Development Advisor for the bits of CSIRO that specialise in maths, physics and IT**.

"Most come to us with a PhD and start on $58K plus super, at the other end of the scale we have what we call Stream Leaders on $200K packages. If you came here with a bachelor's degree you'd be earning in the mid $50s," she says.





"We'd have 105 science-types here, and we hire about ten a year. Most staff have some form of science qualification, whether it's from TAFE or university," says **Ms Brenda McAuliffe, Recruitment Coordinator at AIMS**.

"Graduates start out on $45K, PhDs at $59K, and the maximum you can earn at AIMS and still be doing science is $122K."

As for the future: "Biotechnology is certainly the area where we're growing."

"ANSTO has about 500 scientists, technicians and engineers. We employ roughly 60 per year, and 20 undergraduate students come to work with us for a year as part of their studies," says **Linda Houseman, Senior Human Resources Advisor with ANSTO**.

"New graduates start out at $41K, and our chief research scientists earn $124K.

"One of the drawbacks is that Australia is a small pool. Young scientists are likely to have to travel in order to gain experience. However, this really should be seen as a plus. We actively try to employ Australians who have post doctoral experience overseas."

In Linda's crystal ball, she sees one of the growth areas for science being nanotechnology.

"We have 35 academic staff, 30 technical and administrative staff, and about 40 post docs and research assistants. We hire 2-3 staff per year, plus about 15 post docs," says **Professor Trevor Hambley, head of The University of Sydney's School of Chemistry**.

"Academic salaries have made good ground in recent years. The national average has just passed $50K and I reckon our academic staff average close to twice that. Our standard professorial package is around $135-140K and many are on packages over $150K.

"The so-called enabling sciences of chemistry and physics underpin where the action is. More than 50% of people employed in biotechnology are chemists and small biotechnology and pharmaceutical companies of about 5-10 people are significant employers of chemists.

"There will be lots of jobs in materials science in a few years," Trevor predicts.

"To be a good scientist you need enthusiasm, energy and brains. You've got to have a passion for it and you have to be self-motivated."

"A technical background is great for getting into anything you want to do in business," says **Errol Muir, Group Project Leader of graduate recruitment and development for Rio Tinto**. He ought to know: he's got a maths degree, an economics degree, and now he's doing a PhD in management. "I did maths just because I was good at it in school. I didn't really set out to be a scientist, but it's been useful ever since.

"Rio Tinto Australia hired 90 science graduates in 2004. Most of the engineering disciplines get a go (such as mining, mechanical, process and safety engineering) as well as geology, environmental science and computer science.

"Science graduates start out at more than $50K (and there can be significant site allowances on top of that) and we have experienced engineers on packages greater than $200K.

"A career in science gives you immense flexibility. You can work in technical fields or apply your training and skills to management."

SOME SCIENCE RELATED JOBS

Job Title	What is done daily?
Biomedical scientist	Undertakes research on cancer; develops vaccines and drugs to target malignant cells.
Product development specialist	Researches technological advancements and develops products for diagnostic and research purposes. Trains clients in the use of new products.
Scientific journalist	Investigates and reports on science news stories for the media.
Organic analytical chemist	Analyses amounts and types of drugs, pesticides and other substances in humans and animals, including in sport.
Marine scientist	Undertakes research into the oceans; their evolution, and life forms.
National Parks research officer	Collects natural history information for management of national parks, such as protection of endangered plants' and animals' habitats.
Manager of urban parks and landscapes	Beautifies city areas by landscaping and managing green spaces.
Environmental scientist	Helps manage the environment in a sustainable way by investigating issues such as global warming and salinity.
Ceramist	Designs, manufactures and improves materials used in bricks, concrete and tiles.
Dietician	Consults as a nutritional expert in hospitals or private practices. Develops care plans for those with special requirements such as diabetics or athletes.
Materials analyst	Researches and analyses materials used for electrics, magnetics, biological, optical and mechanical applications.
Genetics	Unlocks the secrets of life, working to discover the origins of disease and birth defects and develops ways to prevent or treat them.
Geologist	Analyses rock formations, studies data and works outdoors. Takes samples and measurements and analyses them in the laboratory.
Mathematician	Uses mathematical theories to solve problems or develop new principles.
Zoologist	Oversees the care and distribution of animals in the zoo and determines the best way to maintain their habitats.
Research scientist	Works towards agreed research objectives producing original ideas and taking overall responsibility for solving a problem.
Biologist	Studies humans, plants and animals and the environments in which they live, outside and in the laboratory.
Forensic scientist	Gives crucial evidence in criminal and civil law courts after examining crime scenes.
Laboratory technician	Assists scientists by carrying out experiments and working out results.
Radiographer	Uses imaging techniques in a hospital or clinic to diagnose or treat disease.

SCHOOL SCIENCE SUBJECTS

To keep your options open, both to pursue a career in science or to put scientific knowledge and/or approaches into practice through other careers, there are subjects in Years 11 and 12 you should consider studying.

Physics Physics looks at energy and matter, and how these things relate, from sub-atomic particles to clusters of galaxies. It looks at how matter moves and what happens when it hits something else. It covers acoustics, mechanics, optics, astronomy, superconductivity and electromagnetism, as well as the mysterious worlds of quantum physics and high-energy particles.

Chemistry Chemistry is about how substances interact: elements with other elements forming compounds and compounds reacting with each other - or not. There are three branches of chemistry: physical (borderline physics, it has a lot to do with the structure of things), organic (unkindly known as smelly chemistry, it deals with carbon-based molecules) and inorganic (everything else).

Biology If it has a life, you can study it in biology. What makes living things tick, how they reproduce and modern stuff such as genetic manipulation. Also, because everything has to live somewhere (even if it's in a beaker on a lab bench), biology includes the inter-relationships between living things and their environment, and how they get on with the neighbours. Biologists study life forms, such as those that live in oceans or volcanic areas.

Earth and Environmental Science Earth and Environmental Science is the study of the planet Earth, its composition and processes, as well as the human impact on its environments. It examines the evolution of the planet over time, the Australian environment and environmental health (or ill-health!).

Geology Geology is the study of rocks and includes planetary science, gemmology and even aspects of forensics. If you want to know how the Earth formed and continues to be shaped by events such as earth-quakes, not to mention what's happening on other planets, then you've got to be up on rocks. Geologists also tell whether an ore body is worth mining, if a particular rock would be good to build with, if a gem any good, and even forensic details such as where a stone stuck in a murdered person's shoe comes from.

Senior Science Senior Science, or generalist science studies, integrates disciplines such as physics, chemistry, biology and geology, and enhances your science literacy. This course, like other science subjects, can even help you in non-scientific careers.

Mathematics Maths gives you neat ways of describing things or solving problems quickly, logically and accurately. For example, figuring out whether a mobile phone deal really is as good as it looks, if a fancy skate stunt will work without risking busting your board, or the chances of winning on Deal or no Deal.

Professional Pay*

Job Title	Average Salary	Range
Chief Chemist	$71 978	$66 500 - $90 956
Senior Professional Scientist	$67 585	$61 317 - $77 697
Professional Scientist	$60 029	$49 842 - $73 076
Laboratory Technician	$39 690	$36 121 - $43 814

*These figures are from 2004 and will increase by a few percent each year.

Glossary

AIMS	Australian Institute of Marine Science
ANSTO	Australian Nuclear Science and Technology Organisation
BSc	Bachelor of Science
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DSTO	Defence, Science and Technology Organisation
IT	Information technology
NASA	National Aeronautics and Space Administration
PhD	Doctor of Philosophy

For further information:

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CSIRO	1300 363 400	enquiries@csiro.au	www.csiro.au
DSTO	03 9626 7131	information@dsto.defence.gov.au	www.dsto.defence.gov.au

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